Plant	Client	Contract Code	Document ID		С	ontract	No.		
1.0 MTPA ALUMINA REFINERY STREAM-5	NALCO	NAL	6695-PIP-G00-EC-0035			66-66	95		
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Plant	Client	Contract Code	Document ID		С	ontract	No.		
1.0 MTPA ALUMINA REFINERY STREAM-5	NALCO	NAL	6695-PIP-G00-EC-0035			66-66	95		
	Teo M	hnical Specifi etallic Expans	cation for ion Joint	<b>न</b> नेश- Natio	<b>िलि</b> नल एल onal A	तो 🔕 यूमिनियम व Iuminium	NAL कम्पनी । Comp	. <b>CO</b> लिमिटेड any Lte	d.
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Plant	Client	Contract Code	Document ID		С	ontract	No.		
1.0 MTPA ALUMINA REFINERY STREAM-5	NALCO	NAL	6695-PIP-G00-EC-0035			66-669	95		
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1	MB503-1229-01	00	
2	MB503-0230-01	00	
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4	MB503-0225-01	00	

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	). B :	1.0 MTPA ALUMINA REFIN	NERY STREAM-	5 NALCO	NAL	66-6695	1 of 1	
		Technical S	<b>Specificati</b>	on Data Sheet		Document ID : 6695-PIP.	-G00-EC-0035	
		Metall	lic Expans	sion Joint		TON ITEM METALLIC REV. 00	EXPANSION BELLOW	
-	Part No.			MB503-1229-C	01 NOTES:	-		
2	Quantity			ONE	1) Refer C	eneral Technical Specification for Metal	lic Expansion Joint (Doc No. PIN-LES-PIP-7003	<b>13, Rev 01)</b>
ю 4	Expansion joint type Construction	/ Material	Note 2.6.10.11	TIED LATERAL BELLOW / A2 AS PFR F.IMA X th FDITION - FC	240 Gr. TP 304 2) Plant li DR 7000 CYCI FS 3) Vendor	e of 20 years corresponds to 7000 cycle to specify. Vendor to specify working si	ss. oring rate also (Ref EJMA clause 4.12.1.7).	
5	Internal Sleeve		Note 5,7		no 4) Vendor	to inform minimum length required achi	ieving the given stiffness values.	
9	Nominal Size			200 NB	5) Sleeve	diameter to be worked out considering l	ateral deflection. Refer 4.10.2.f of EJMA.	
7 8	Unit weight		kg	VENDOR TO SPEC	CIFY 6) Vendoi   2.HC_75 7) Sleave	to check component design as per 9.2.3 thickness calculations as per F.IMA clair	3.3 (Table II) of EJMA. Ise 4.10 to be submitted Provide drain holes in	in sleeve.
, 6	Installation (Vertical /	Horizontal)		Horizontal	8) Minimu	m tie rod size shall be as per 9.2 of EJM.	A.	
10	Fluid – Description an	nd Velocity	Note 7,13	LIVE STEAM CONDENSATE	0.862 m / sec 9) Paintin	g spec ES-Y1. For carbon steel parts on	ly.	
1	State			□ gaseous   ⊠	liquid 10) Vendor	to check bellows stability as per 4.12.1.	6 of EJMA.	
12		<b>Operating / Design pressure</b>	kg/cm2 g	5.9/14	11) Vendor	to submit design calculations as per EJ	IMA.	
13	Pressure		kg/cm2 g	- 5	12) Vendor	to provide calculations for bellows natu	iral frequency as per EJMA clause 4.9.	
<u>5</u>	Temp	Doerating / Max. OPE. temperature		158/300	13) Fluid U	s shall be designed for pressure thrust 8	s full vacuum load.	
16		Installation temperature	, °	21				
17		Axial movement	mm					
18		Lateral movement	mm	5				
19	Movements	Angular movement	deg	)  - [				
20		Pretension		L yes X	ou			
22	Chrind rate	Avial soring rate (Assembly)	Mm Mm/M					
23	incl.	Lateral spring rate (Assembly)	Mm/N	- 589			TIED LATE	ERAL
24	Friction	Angular spring rate (Individual)Note-3	Nm/deg				BELLOW	
25		Effective area	mm²	VENDOR TO SPEC	SIFY		MB503-122	29-01
26		Designation		Inlet	Outlet			
27		Flange connection		X yes     no   X ASME D 16.5				
20	-	Facing		AGME D 10.0	AGME D 10.0			
30		Nominal size		200 NB	200 NB			
31	Type of end	Nominal pressure		CLASS 300	CLASS 300			
32		Materia		ASTM A 105	ASTM A 105			
33		Welding end Outside diameter × Wallthickness	uu	L yes X no L	yes 🛛 no			
35		Welding end standard						
36		Material (END PIPE & MID PIPE)			-			
37		Total length (L) (Note 4)	mm	378		/		
89 02	Corrections	/ for itome in touch with fluid )	E S	VENDUR 10 SPEC				
20 70	Cortificatos	I DO REFINS IN COUCH WITH HULD			2	Elou: Dimotion		
41		Inspection certificate acc. EN 10204 (D	OIN 50049)	2.2	1			
42		TKIS-India			0			
43	Inspection	Third Party			0		6	
44	Dainting	Of elements (excent hellows) acc Bain	+ Snac (Nota 9)		0			
46	Stress System No.	OI CICILICITS (EXCEPT DEILOWS) ACC. I all		SA-073				
47	Machine RPM	RPM of machine near which the expan	sion joint is	NOT APPLICABL	щ			
48	Insulation			Thk = 75 mm (Tie Rods to be out:	side the insulation)			
50	Special							
	Requirement 1							

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	Ð. :	1.0 MTPA ALUMINA REFIN	<b>VERY STREAM-</b>	5 NALCO	NAL		66-6695	1 of 1	
		Technical S	pecificati	ion Data Sheet		Docum	ant ID: 6695-PIP-G00-EC-00	035	_
		Metall	lic Expans	sion Joint		TON ITEN REV	METALLIC EXPANSIC	ON BELLOW	
-	Part No.			MB503-0230-0	01 NOTE	ö			_
7	Quantity			ONE	1) Re	fer General Technical Sp	ecification for Metallic Expansion	n Joint (Doc.No. PIN-LES-PIP-7003, Rev 01)	<b>.</b>
<del>ه</del> 4	Expansion joint type Construction	/ Material	Note 2.6.10.11	AS PER EJMA X th EDITION - FC	240 Gr. TP 304 2) PIS 2R 7000 CYCLES 3) Ve	ant lite of 20 years corres ndor to specify. Vendor t	ponds to 7000 cycles. o specifv working spring rate als	to (Ref EJMA clause 4.12.1.7).	
2	Internal Sleeve		Note 5,7		no 4) Ve	ndor to inform minimum	length required achieving the giv	ven stiffness values.	-
9	Nominal Size			200 NB	5) SIC	seve diameter to be work	ed out considering lateral deflect	tion. Refer 4.10.2.f of EJMA.	<u> </u>
7 8	Unit weight		kg	VENDOR TO SPEC	JFY 71 Ve	ndor to check componer	it design as per 9.2.3.3 (Table II) o ne as ner F IMA clause 4.10 to be	of EJMA. seuthmitted Provide drain holes in sleeve	-,-
5	Installation (Vertical /	Horizontal)		Horizontal	8 Mi	nimum tie rod size shall l	te as per 9.2 of EJMA.		
10	Fluid – Description an	d Velocity	Note 7,13	LIVE STEAM CONDENSATE	0.862 m / sec 9) Pa	inting spec ES-Y1. For ca	Irbon steel parts only.		- <u>-</u>
1	State			□ gaseous □	liquid 10) Ve	ndor to check bellows st	ability as per 4 12 1.6 of EJMA.		
12		<b>Operating / Design pressure</b>	kg/cm2 g	59/14	11) Ve	ndor to submit design ca	Iculations as per EJMA.		<b>—</b>
13	Pressure	Vacuum	kg/cm2 g	I	12) Ve	ndor to provide calculati	ons for bellows natural frequency	y as per EJMA clause 4.9.	
14	5.00 F	Test pressure	kg/cm2 g	21	13) FIL	lid density = 910 kg / m3	Flow rate = 109 I/hr.	200	
10	lemp.	Operating / Max, OPE, temperature	ې ر	1001	14) 116	rous snall be designed	or pressure thrust & tull vacuum	1 1080.	
17		Avial movement							-
18		Lateral movement	um	L LL					
19	Movements	Angular movement	deg						
20		Pretension		□	no				
21	Course webs	Pretension Value	mm						
77	apring rate	Axial spring rate (Assemoly) I ateral soring rate (Assembly)						TIED LATERAL	
24	Friction	Angular spring rate (Individual)Note-3	Nm/dea					BELLOW	
25		Effective area	mm²	VENDOR TO SPEC	JFY			MB503-0230-01	
26		Designation		Inlet	Outlet				
27		Flange connection		X yes I ho X	yes D no				
20		rlange standard Escinc							
30		Nominal size		200 NB	200 NB				
31	Type of end	Nominal pressure		CLASS 300	CLASS 300				
32		Material		ASTM A 105	ASTM A 105			1.00	
33		Welding end Outside diamater v Wellthickness	ww	□ ves ⊠ no □	yes 🛛 no				
35		Welding end standard							
36		Material (END PIPE & MID PIPE)		-	-				
37		Total length (L) (Note 4)	mm	378					
30 20	Corrosion allowance	/ for items in fouch with fluid )		0 mm EOP SS / 3 mm I	EDBICS				
64	Certificates	Inspection certificate acc. EN 10204 (D	OIN 50049)			Flow	v Direction		
41		Inspection certificate acc. EN 10204 (D	0IN 50049)	0 2.2					
42		TKIS-India		D yes 🛛 no					
43	Inspection	Ihird Party Client							
45	Painting	Of elements (except bellows) acc. Pain	t. Spec.(Note 9)			2		-	
46	Stress System No.			SA-073					
47	Machine RPM	RPM of machine near which the expans	sion joint is	NOT APPLICABL	ц.				
48	Natural Fraction		(Ninte 12)						
20	Special Special								_
	Requirement 1								

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	æ.	1.0 MTPA ALUMINA REFIN	JERY STREAM-	5 NALCO	NAL	66-6695	1 of 1
		Technical S	pecificati	ion Data Sheet		Document ID : 6695-PIP-G00-EC-003	35
		Metall	ic Expans	sion Joint		TON ITEM METALLIC EXPANSIO	N BELLOW
-	Dart No				NOTES.	REV. 00	
-				MB503-0215-01	MOLES.		
2	Quantity			ONE	1) Refer General Ter	chnical Specification for Metallic Expansion .	Joint (Doc.No. PIN-LES-PIP-7003, Rev 01)
en en	Expansion joint type	/ Material		TIED LATERAL BELLOW / A240 Gr. TP 304	2) Plant life of 20 ye	ars corresponds to 7000 cycles.	
4	Construction		Note 2,6,10,11	AS PER EJMA X th EDITION - FOR 7000 CYCLES	3) Vendor to specify	· Vendor to specify working spring rate also	(Ref EJMA clause 4.12.1.7).
5	Internal Sleeve		Note 5,7	🛛 🗌 yes 📔 🗍 no	4) Vendor to inform	minimum length required achieving the give	en stiffness values.
9	Nominal Size			200 NB	5) Sleeve diameter t	o be worked out considering lateral deflectio	on. Refer 4 10.2 f of EJMA.
~ «	Unit weight		Kg	VENDOR 10 SPECIFY PC1-503-0215-2000-HC-25	8) Vendor to check 7) Sleave thickness	component design as per 9.2.3.3 (Table II) of calculations as nor F IMA clause 4.10 to be s	r EJMA. submitted Provide drain holes in sleeve
6	Installation (Vertical /	Horizontal)		Horizontal	8) Minimum tie rod	size shall be as per 9.2 of EJMA.	
<del>9</del>	Fluid – Description an	d Velocity	Note 7,13	PROCESS CONDENSATE 1.026 m / sec	9) Painting spec ES	Y1. For carbon steel parts only.	
÷	State				10) Vandor to check	allows stability as nor 4 12 1 6 of E IMA	
= <del>;</del>	olate	Onerating / Design pressure	kalem2 a		11) Vendor to submit	design calculations as per + 12.1.0 of LUMA.	
13	Pressure	Vacuum	kg/cm2 g		12) Vendor to provide	s calculations for bellows natural frequency (	as per EJMA clause 4.9.
14		Test pressure	kg/cm2 g	21	13) Fluid density = 95	i7 kg / m3. Flow rate = 95 T/hr	
15	Temp.	Operating / Max. OPE. temperature	°c	128 / 200	14) Tie rods shall be	designed for pressure thrust & full vacuum I	load.
16		Installation temperature	ç	21			
17	- - -	Axial movement	mm		Ţ		
9		Lateral movement	mm	5			
50	Movements	Angular movement Drotonsion	aeg				
21 FC		Pretension Value	um				
52	Spring rate	Axial spring rate (Assembly)	N/mm		T		
23	incl.	Lateral spring rate (Assembly)	N/mm	589			TIED LATERAL
24	Friction	Angular spring rate (Individual)Note-3	Nm/deg				BELLOW
25		Effective area	mm²	VENDOR TO SPECIFY			MB503-0215-01
26		Designation		Inlet Outlet			
2/		Flange connection Flange standard		X   yes     no   X   yes       ASMF B 16 5	OU		
29		Facing		RF RF			
30		Nominal size		200 NB 200 NB			
31	Type of end	Nominal pressure		CLASS 150 CLASS 150			
32		Waterial Welding end		ASIMATUS ASI	G		
34		Outside diameter x Wallthickness	m		2		
35		Welding end standard					2
36		Material (END PIPE & MID PIPE)					6
37	_	Total length (L) (Note 4)	mm	378			
38	Dimensions	Maximium width	mm	VENDOR TO SPECIFY		5	
50	Corrisionaliowance	( TOF ITEMS IN TOUCH WITH TIULD )			T		
41	Ceruiicates	Inspection certificate acc. EN 10204 (D Inspection certificate acc. EN 10204 (D	IN 50049)			Flow Direction	
42		TKIS-India					
43	Inspection	Third Party		□ yes ⊠ no			
4:	;	Client		X yes D no			/
45	Painting	Of elements (except bellows) acc. Paint	t Spec (Note 9)	X   yes   L   no			
40	Diress bystem No.	DDM of more seen and the second	ion ioint io				
4/	Insulation			Thk = 75 mm (Tie Rods to be outside the insulation)			
49	Natural Frequency		(Note 12)	VENDOR TO SPECIFY			
50	Special				[		
	Requirement 1						

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	۰. ۲.	1.0 MTPA ALUMINA REFIN	VERY STREAM-{		NAL	66-6695	1 of 1
		Technical S	pecificati	on Data Sheet		Document ID : 6695-PIP-G00-EC-0035	
		Metall	lic Expans	sion Joint		TON METALLIC EXPANSION BELLI REV. 00	-ow
-	Part No.			MB503-0225-01	NOTES:		
2 6	Quantity Evenueion joint tuno	/ Matarial		ONE TIER LATERAL BELLOW A240	C: TD 201 01 DI Cefer General 1	echnical Specification for Metallic Expansion Joint (Dou	oc.No. PIN-LES-PIP-7003, Rev 01)
0 4	Construction	/ Material	Note 2.6.10.11	AS PER F.IMA X th EDITION - FOR	7000 CYCI FS 33 Vendor to speci	reals corresponds to 7000 cycles. fv. Vendor to specify working spring rate also (Ref EJM	MA clause 4-12-1-7).
5	Internal Sleeve		Note 5,7	X yes 7	no 4) Vendor to infor	n minimum length required achieving the given stiffnes	ss values.
91	Nominal Size			200 NB	5) Sleeve diamete	to be worked out considering lateral deflection. Refer	4.10.2.f of EJMA.
7 8	Unit weight		kg	VENDOR 10 SPECIF PC1-503-0255-200C-HC	Y Vendor to chec 75 77 71 Sleeve thicknes	k component design as per 9.2.3.3 (Table II) of EJMA. s calculations as per F-IMA clause 4.10 to be submitted	d Provide drain holes in sleeve
6	Installation (Vertical /	Horizontal)		Horizontal	8) Minimum tie rou	I size shall be as per 9.2 of EJMA.	
9	Fluid – Description an	nd Velocity	Note 7,13	PROCESS CONDENSATE , 1.0	01 Painting spec E	S-Y1. For carbon steel parts only.	
1	State			□   gaseous   ⊠	liquid 10) Vendor to chec	c bellows stability as per 4.12.1.6 of EJMA.	
12		<b>Operating / Design pressure</b>	kg/cm2 g	46/14	11) Vendor to subn	it design calculations as per EJMA.	
13	Pressure	Vacuum	kg/cm2 g	- 3	12) Vendor to provi	de calculations for bellows natural frequency as per EJ	JMA clause 4.9.
14	Tamn	Test pressure Onerating / May, ODE temperature	kg/cm2 g	21	13) Fluid density =	957 kg / m3. Flow rate = 95 1/hr. 3 designed for pressure thrust & full vectum load	
16		Uperating / max. Or L. terriperature	່	1201 200		e designed for pressure till det & full vacuum load.	
17		Axial movement	, mm				
18		Lateral movement	mm	5			
19	Movements	Angular movement	deg	0 - -			
50		Pretension		U yes X	ou		
7	Contract under	Ariel and a solo Value	Mm M	-			
23	incl.	Axial spring rate (Assembly) Lateral spring rate (Assembly)	Mmm/N	- 589			TIED LATERAL
24	Friction	Angular spring rate (Individual)Note-3	Nm/deg				BELLOW
25 26		Effective area	mm²	VENDOR TO SPECIF			MB503-0225-01
27	•	Pesignation Flance connection					
28		Flange standard		ASME B 16.5 A	SME B 16.5		
29		Facing		RF	RF		
30		Nominal size		200 NB	200 NB		
32		Notititat pressure Material		ASTM A 105 A	STM A 105		
33		Welding end			yes 🛛 no		
34		Outside diameter x Wallthickness	mm				24
35 36		Welding end standard					
37		Total length (L) (Note 4)	mm	378			S
38	Dimensions	Maximium width	mm	VENDOR TO SPECIF	Υ		
39	Corrosion allowance	( for items in touch with fluid )	mm	0 mm FOR SS / 2 mm FO	R CS		
40	Certificates	Inspection certificate acc. EN 10204 (L Inspection certificate acc. EN 10204 (D	NN 50049)			Flow Direction	
42		TKIS-India					
43	Inspection	Third Party		ves Name		-	
44	Dainting	Client Of alomouth (occount hollowe) and Bain	+ Enco (Noto 0)	X Ves			6
46	Stress System No.	OI EIEIIIEIIIS (EVCEDI DEIIOMS) ACC. LAII	IL OPEC (NOLE 3)	SA-079			1
47	Machine RPM	RPM of machine near which the expan	sion joint is	NOT APPLICABLE			
48	Insulation		(Nicto 12)	Thk = 75 mm (Tie Rods to be outside	e the insulation)		
20	Special				_		
	Requirement 1						

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			PIN-LES-PIP-7003						
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	SCOPE REFERENCE DOCUMENTS DESIGN TESTING AND INSPECTION MARKINGS GUARANTEE PAINTING PACKING AND TRANSPORTATION SUBMISSION OF DRAWINGS AND DOCUMENTS

## Attachments and Forms

PIN-QMC-03-F101 03-2015

F01 -	Schedule of Deviation from General technical Specification	1 Page
F02 -	Technical Specification Data Sheet for Metallic Expansion Joint	1 Page

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01		Revised as marked and issued for reference.	03-07-2018	APG	03-07-2018	RPG	03-07-2018	HSS	
00		Previous Doc.No. GENL-PI-UZ-0076 REV-1, is revised and reissued as PIN-LES-PIP-7003 due to new document numbering philosophy.	24-07-2015	APG	24-07-2015	RPG	27-07-2015	Sd/-HSS	-
Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
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### 1 SCOPE

This specification covers the technical requirements for the design, supply, fabrication, inspection and testing of the metallic expansion bellow.

The vendor shall demonstrate that bellow meets the requirement of this specification and latest edition of the applicable codes and standards.

### 2 REFERENCE DOCUMENTS

Latest issues, amendments and supplements of the documents shall apply, unless otherwise mentioned.

- 2.1 Technical Specification Data Sheet
- 2.2 Expansion Joint Manufacturers Association (EJMA)
- 2.3 ASME B 31.3 Appendix-X
- 2.4 Any other standard document required to carry out requirements specified in this specification.

### 3 DESIGN

- 3.1 Design shall be as per the requirements of Expansion Joint Manufacturers Association (EJMA) and ASME B 31.3 Appendix-X.
- 3.2 Presetting of bellows is not acceptable, unless otherwise specified in technical specification sheet.
- 3.3 Assembly lengths given in technical specification are final, unless mentioned otherwise.
- 3.4 Spring rates indicated are maximum values. Manufacturing tolerance on positive side is not acceptable.
- 3.5 Dimensions specified in the technical specification for Expansion Joint under the heading "End Connection" for Butt Welding end (OD x Wall thick) is the matching pipe dimension only. The vendor shall ensure that the thickness / design for the end pipe piece of the bellow is made taking into consideration all the external and internal forces developed due to pressure thrust and pipe load which are transferred through tie / limit rods.
- 3.6 Tie / limit rods for the bellows, shall be designed to take the pressure thrust and specified pipe load.
- 3.7 Number of tie rods / limit rods and their sizes shall be decided by the vendor, taking into consideration adequacy of the same from the point of view of strength to withstand external loading and stability of the bellow for its proper working during operating condition.
- 3.8 For bellow working under vacuum condition, calculation shall also be done as per EJMA considering the effect of "<u>External Pressure</u>".
- 3.9

For such bellows, pressure thrust absorbing member (tie rods / limit rods / hinges / gimbals) shall be evaluated in the same manner as for an internally pressurised system. However, the effects of compression loading on slender members (viz. long tie rods / limit rods) must be taken into account.

3.10 Welding of dissimilar material directly on end pipe piece or intermediate spool piece of the bellow shall not be accepted. A suitable pad of same material as pipe shall be welded at the interface, before welding of dissimilar materials.

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3.11 During the construction of multiply expansion bellows, the manufacturer shall ensure that the space between the plies is free of moisture / air pockets. This is to avoid the bursting effect due to expansion of trapped moisture / air between the plies.

### 4 TESTING AND INSPECTION

Following tests to be carried out as per the requirements/procedures/criteria mentioned in Expansion Joint Manufacturers Association (EJMA) and ASME B 31.3 Appendix-X.

- 4.1 Visual / Dimensional Inspection
- a) Construction features (e.g. no of plies, no of convolutions, OD/ID of convolutions, sleeve requirements, position of drain hole in sleeve etc.)
- b) Assembly length/width/diameters
- c) Tie rod arrangements
- d) Markings
- e) Name plate details
- 4.2 <u>Non-Destructive Testing</u>
- 4.2.1 100% Radiographic Examination shall be carried out for longitudinal seam welds of bellow, before bellows are convoluted.
- 4.2.2 Liquid Penetration Examination shall be performed for entire assembly after forming and welding but before hydro testing. This test shall be witnessed by TKIS-India/client.
- 4.2.3 Longitudinal pipe welds, girth welds shall be examined by 100% radiography. The weld seam between internal sleeve and pipe shall be examined by liquid penetrant test.
- 4.2.4 Pressure Test (Hydrotest)
- a) The test pressure shall be taken as given in respective technical specification data sheet considering temperature correction factor as per EJMA.
- b) The water having chloride content less than 50 ppm shall be used for hydrostatic testing of austenitic stainless steel material.
- c) For large expansion joints, additional supports shall be provided to support the weight of the water used during hydro test.
- d) Hydrostatic testing shall be witnessed by tklS-India/client. The acceptance criteria for the pressure testing are the absence of leakage in the expansion joint assembly and distortion of bellow as well as tie rod assembly to an extent approved by tklS-India/client.
- e) The following guide lines shall be followed for pressure testing of various types of bellows:

Axial bellow (without limit rod) :

- The bellow shall be tested hydrostatically, with ends fixed (restrained) properly by means of some rigid fixtures, so that the pressure thrust during testing can be absorbed by the restraints without causing any deformation at the convolutions of the bellows.

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Axial bellow (with limit rod)/ lateral Bellow (with tie rod) / Bellows (with hinges/gimbals)

- During the pressure testing of the above type of bellows, the ends shall be blanked, but must not be held between two fixed restraints.
- However, the bellows can be guided at suitable locations for maintaining its alignment during testing.
- The bellow assembly shall be tested under such condition, so that the tie rods, limit rods, hinges/gimbals are also subjected to external loading due to pressure thrust.
- This method of testing will indicate the presence of leakage, if any and verify the structural integrity of the item being tested as well as the stability of the bellows.
- f) Vendor shall furnish the test procedure to TKIS-India/client for review/comment, prior to test.
- 4.2.5 Vacuum Test

Wherever full vacuum test is asked in technical specification, the expansion bellow shall be tested at 730 mm of Hg. vacuum.

The arrangements for testing under vacuum condition shall be same as during pressure testing described above.

## 4.2.6 Deflection Test

- Deflection test shall be carried out for maximum permissible movements in any direction when **induced individually or simultaneously. This is to ensure that bellows deflect for the designed** movement without any obstruction in fully assembled condition.

- Axial deflection will be seen by deflecting the bellows axially. The lateral and angular deflection by deflecting the bellows laterally and angularly. No equivalent movement need to be seen.

4.3 Positive Material Identification (PMI) Test

In case of Alloy steel and stainless steel material and welds, PMI test shall be carried out during final inspection and reports shall be furnished by vendor.

4.4 Material Test Certificates

The material test certificates for all pressure retaining components shall be furnished by vendor for review of the tklS-India/client.

## 4.5 Cycle Life Test Certificates

Guarantee (certificate) for the no. of life cycles specified in the data sheet shall be furnished by the vendor.

## 5 MARKINGS

Following details shall be embossed on name plate of each expansion joint, as a minimum.

- tklS-India tag number
- Rated pressure/temperature
- Axial/lateral/Angular Movement, as applicable

The expansion joint must have the flow direction clearly marked and attached on the assembly in two places, 180 degrees apart.

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### 6 GUARANTEE

The bellow assembly shall be guaranteed for a trouble free operation for 12 months from the date of commissioning or 18 months from the date of supply or as per PO terms.

### 7 PAINTING

All carbon steel parts shall be painted with two coats of synthetic enamel / silicon paint suitable to withstand operating temperature of bellow.

### 8 PACKING AND TRANSPORTATION

- 8.1 Expansion joint should be properly packed in wooden boxes for transportation. Bellows shall be protected during transportation and operation by a removable outer shroud. Bellow ends should be protected.
- 8.2 Each expansion joint shall be completely preassembled and packaged as an individual unit. There shall not be loose pieces.
- 8.3 Carbon steel fixtures used for the purpose of transportation shall not be welded to any stainless steel part of bellow assembly.
- 8.4 Transportation / Shipping devices as indicated above shall be painted yellow or otherwise distinctively marked with instruction for removal only after installation of expansion joint assembly in the piping system.
- 8.5 A copy of instructions shall be inserted in a plastic envelope and enclosed with its respective assembly.

### 9 SUBMISSION OF DRAWINGS AND DOCUMENTS

Drawings and documents to be submitted at different stages shall be as under :-

### 9.1 Along with Quotations:

- 9.1.1 Vendor shall submit relevant catalogue from which they are offering bellows.
- 9.1.2 Vendor shall submit Three (3) copies of assembly drawings for bellows incorporating all dimensional details and material specification for all items.
- 9.1.3 Vendor shall submit standard quality control documents.
- 9.1.4 Deviations from this document shall be indicated by the vendor clause by clause in the attached sheet (F01) under the title <u>"Schedule of Deviations from General Technical Specification".</u>
- 9.1.5 Deviations from the data and information in the "Technical Specification Data-Sheet" as well as data/information required from the vendor, as marked in the "Data-Sheet", shall be indicated / furnished by the vendor in the "Data-Sheet" itself.
- 9.2 <u>After Letter of Intent / Order</u>:
- 9.2.1 After placement of order, tklS-India shall issue Technical Order Specification to vendor after incorporating the acceptable deviations (if any).

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- 9.2.2 Within four weeks of the effective date of LOI/Order, the vendor shall submit three(3) copies of following to tkIS-India/client for review/approval before starting the manufacturing:
  - a. Fabrication drawings
  - b. Design calculations
  - c. Quality assurance plan
  - d. WPS/PQR with welder qualification

9.2.3 The fabrication drawings shall include following, as a minimum:

- a. All parts clearly indicated with the material grades for individual parts
- b. All dimensions
- c. Welding details
- d. Design parameters like pressure, temperature, flowrates, displacements, spring rate values ( for individual element as well as assembly) etc.
- e. Details of convolutions, end connections, internal sleeve, tie rod / lugs etc.
- All the required tests with parameters / conditions. f.
- g. Painting requirements with surface finish.

9.2.4 The design calculations shall include the following, as a minimum :

- a. Bellow design calculations as per EJMA, which includes the following:
  - Membrane & Bending Stress due to Pressure and Deflection 1)
  - 2) Fatigue Life Cycles
  - Limiting Internal Design Pressure based on Column Instability Bellow Theoretical Axial Spring Rate Calculations 3)
  - 4)
  - 5) Internal Sleeve Criteria and Thickness Calculations
  - External Pressure (Vacuum) Design calculations
- b. Calculations for other parts like tie rods/limit rods, lug brackets and stiffeners etc.
- c. All welding strength calculations.
- 9.3 Final Documentation:

As the bellows are released after inspection and testing, following drawings and documents shall be submitted within one week

- 9.3.1 Three (3) copies of as-built fabrication drawing and design calculations
- 9.3.2 Two (2) copies of installation instructions/precautions.
- 9.3.3 Three (3) copies of pressure and/or vacuum test certificates.
- 9.3.4 Three (3) copies of material test certificates.
- 9.3.5 Three (3) copies of other test certificates like radiography, LP test etc.
- 9.3.6 Three (3) copies of Final approved QAP
- 9.3.7 Three (3) copies of WPS/PQR and weld map
- 9.3.8 Three (3) copies of Heat treatment reports/chart

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# SCHEDULE OF DEVIATIONS FROM GENERAL TECHNICAL SPECIFICATION

All deviations from the specification shall be filled in by the vendor clause by clause in this schedule and submitted during quotation.

CL.NO.	DESCRIPTION	DEVIATION

The vendor hereby certifies that the above mentioned are the only deviations from "General Technical Specification" of the enquiry.

SIGNAUTRE	
DESIGNATION	
COMPANY	
DATE	

COMPANY SEAL

ISSUE

DATE

Page	PIN-LES-PIP-7003-F02, Rev.01 TON ITEM REV.	r Ganeral technical Snacification for Metallic Eventsion Lint ( Dec No. 2011) ES.200-2003)	ו defined rectificat specification for metallic באמווסטין טעווון בטטיינעי דוויד-בטין וויד-בטין אין איישין אייש ti life of 20 years corresponds to 7000 cycles	dor to specify. Vendor to specify working spring rate also (Ref EJMA clause 4.12.1.7). dor to inform minimum length required achieving the given stiffness values.	we diameter to be worked out considering lateral deflection. Refer 4.10.2.f of EJMA.	dor to check component design as per 9.2.3.3 (Table II) of EJMA. .ve thickness calculations as per EJMA clause 4.10 to be submitted. Provide drain holes in sleeve.	tite rod size shall be as per 9.2 of EJMA. 100 spece ES-11, For catolon steel parts only. dor to check bardious steel parts 10.1.6 of EJMA.	dor to submit design calculations as per EJMA.	dor to provide calculations for bellows natural frequency as per EJMA clause 4.9. d d <mark>en</mark> sity = xxxx kg / m3. Flow rate = xxxxx kg / hr.	ow is close to compressor exhaust. Clause 4.10.1.c of EJMA to be followed. ods shall be designed for pressure thrust / full vacuum load.	DICED A CENTENTRY $X = X + M + M + M + M + M + M + M + M + M +$	DISTLAUEMENTS: $A = 03$ IIIII, $L = 20$ IIIII.		0 VIEW	Y . 7				EXPANSION JOINT IN VERTICAL		FLOW DIRECTION											HLCIM		2290		
Sr Code		VOxxxx VOXES:	ED (LATERAL) / SS-304L 2) Plan	EDITION- FOR 7000 CYCLES 3) Ven	1200 NB 51 Slee	DR TO SPECIFY 6) Venc   A+H60 / UPSTREAM OF 12E014/N01 7) Slee	Vertical 8) Min   Gas, Vel =m/s 9) Pain   Interview 100 Vertical	2.2/4.4 11 Ven	NA 12) Ven r ASME B 31.3) 13) Flui	200 / 230   14) Belly 21   15) Tier		er Uisplacements')			450 N/mm	DR.TO SPECIFY	Outlet	to ves X no				1219 X 9.53 ASME R 16 25	A312 Gr TP 304L	fer SKETCH DR TO SPECIFY	1.5	2.5				APPLICABLE	e to be outside the insulation) for To Snecify	(compressive)	in North-South direction during			
Custom	inical Specification Data Sheet Metallic Expansion Joint		UNIVERSAL TI	Note 2,6,10,11 AS PER EJMA IX th   Note 5.7 I ves		kg VEND   1200-GNO4-12153-EC55CFC	Note 7,13,14 Nitrous	barg	barg darg (As p	<u>\$</u>	u u u	deg 69 (Ke	yes	Nmm	N/mm Nm/dec						X ves	mm 1219 X 9.53 ASME R 16.25	A312 Gr TP 304L	mm Ke	mm mm	IN 50049) 🛛 3.1 L			t. Spec.(Note 9) 🖂   yes   🗌	sion joint is NO <sup>-</sup>	Thk = 60mm (Tie Rods haven and the second se	icable) 25 km	Tie rods orientation shall b	on shall be installation.		Issued for Enguiry Description
Plant	Tech		Material				Horizontal) Id Velocity	Operating / Design pressure	Vacuum Test pressure	Operating / Design temperature Installation temperature	Axial movement	Lateral movement Angular movement	Pretension Drefension Value	Axial spring rate (Assembly)	Lateral spring rate (Assembly)	Effective area	Designation	Flange connection Flange standard	Facing	Nominal size Nominal pressure	Material Welding end	Outside diameter x Wallthickness	werding end standard Material	Total length (Note 4) Maximium width	( for CS metallic parts )	Inspection certificate acc. EN 10204 (D Inspection certificate acc. EN 10204 (Di	TKIS-India Third Partv	Client	Of elements (except bellows) acc. Paint	RPM of machine near which the expans		Other Piping Loads on tie rods ( if appli	<u>(Tie rods to be designed for this load)</u> Tie Rod orientation ( if applicable)	(In case of two tie rods, exact orientatic specified according to calculations)		Chkd
ThyssenKrupp Industrial Solutions (India)		1 Part No.	2 Quantury 3 Expansion joint type/	4 Construction 5 Internal Sleeve	6 Nominal Size	7 Unit weight 8 Line No./ Location	9 Installation (Vertical / 10 Fluid – Description an 11 State	12	13 Pressure	15 Temp. 16	17	18 Movements	20	22 Spring rate	23 incl.	25 FILCUUI	26	28	29	30 Type of end	32	34	36	37 Dimensions	39 Corrosion allowance	40 Certificates	42 A3 Inspection	44	45 Painting 46 Strees Svetem No	47 Machine RPM	48 Insulation 49 Natural Frequency	50 Special	51 Requirement 1 51 Special	Requirement 2		